

What is claimed is:

1. A high power, radio frequency matching network for a plasma processing system, the matching network comprising:

a match network component including one or more variable inductive elements including a magnetic core, a helical coil, and an actuator configured to physically translate the magnetic core through the helical coil.

2. The matching network of claim 1, wherein the plasma processing system is a magnetically enhanced capacitively-coupled plasma reactor.

3. The matching network of claim 1, wherein the plasma processing system is a two-frequency capacitively coupled plasma reactor.

4. The matching network of claim 1, wherein the plasma processing system is a capacitively coupled plasma reactor.

5. The matching network of claim 1, wherein the plasma processing system is an inductively coupled plasma reactor.

6. The matching network of claim 1, wherein the plasma processing system is a transformer coupled plasma reactor.

7. The matching network of claim 1, wherein the plasma processing system is an electron cyclotron resonance plasma reactor.

8. The matching network of claim 1, wherein the plasma processing system is a Helicon plasma reactor.

9. The matching network of claim 1, wherein the matching network is configured to deliver a maximum radio frequency power of 500 watts.

10. The matching network of claim 1, wherein the matching network is configured to deliver a maximum radio frequency power of 1500 watts.

11. The matching network of claim 1, wherein the matching network is configured to deliver a maximum radio frequency power of 2500 watts.

12. The matching network of claim 1, wherein the matching network is configured to deliver a maximum radio frequency power of 3500 watts.

13. The matching network of claim 1, wherein the matching network is configured to deliver a maximum radio frequency power of 4500 watts.

14. The matching network of claim 1, wherein the matching network is configured to deliver a maximum radio frequency power of 5000 watts.

15. The matching network of claim 1, wherein the temperature factor of permeability for the one or more variable inductive elements is within the range of -1×10^{-6} to 40×10^{-6} .

16. The matching network of claim 1, wherein the magnetic core of the one or more variable inductive elements has a Curie temperature greater than 150°C.

17. The matching network of claim 1, wherein the magnetic core of the one or more variable inductive elements has a Curie temperature greater than 200°C.

18. The matching network of claim 1, wherein the magnetic core of the one or more variable inductive elements has a Curie temperature greater than 250°C.

19. The matching network of claim 1, wherein the magnetic core of the one or more variable inductive elements has a Curie temperature greater than 300°C.

20. The matching network of claim 1, wherein the magnetic core of the one or more variable inductive elements has a Curie temperature greater than 350°C.

21. The matching network of claim 1, wherein the magnetic core of the one or more variable inductive elements has a Curie temperature greater than 400°C.

22. The matching network of claim 1, wherein the match network component is configured in a L circuit topology.

23. The matching network of claim 1, wherein the match network component is configured in a T circuit topology.

24. The matching network of claim 1, wherein the match network component is configured in a Pi circuit topology.

25. The matching network of claim 1, wherein the match network component includes a filter component.

26. The matching network of claim 1, wherein the magnetic core is made of NiZn ferrite – Type 61.

27. The matching network of claim 1, wherein the match network component further comprises at least one reactive element and at least one capacitive element coupled to the one or more variable inductive elements.

28. The matching network of claim 27, wherein the match network component further comprises at least one additional inductive element.

29. The matching network of claim 1, wherein a surface area of the magnetic core includes at least one of longitudinal and latitudinal grooves facilitating cooling of the magnetic core.

30. The matching network of claim 1, wherein the magnetic core of the one or more inductive elements is the only movable element of the variable inductive elements and any radio frequency current-carrying coils included in the impedance matching network are stationary.

31. The matching network of claim 1, wherein moving the magnetic core in and out of the helical coil changes the variable inductive element's inductance.

32. A plasma processing system comprising:
a high power, radio frequency matching network including a match network component including one or more variable inductive elements including a magnetic core, a helical coil, and an actuator configured to physically translate the magnetic core through the helical coil.

33. The plasma processing system of claim 32, wherein the further comprising a filter component located between an RF source of the system and the match network component.

34. The plasma processing system of claim 32, further comprising a filter component located between a plasma load of the system and the match network component.

35. The plasma processing system of claim 32, further comprising an inductively coupled plasma source.

36. The plasma processing system of claim 32, further comprising a transformer coupled plasma source.

37. The plasma processing system of claim 32, further comprising a Helicon plasma source.

38. The plasma processing system of claim 32, further comprising an electron cyclotron resonance plasma source.

39. The plasma processing system of claim 32, further comprising a capacitively coupled plasma source.

40. The plasma processing system of claim 32, further comprising a two-frequency capacitively coupled plasma source.

41. The plasma processing system of claim 32, further comprising a magnetically enhanced capacitively coupled plasma source.

42. The plasma processing system of claim 32, wherein the at least one of the one or more variable inductive elements is also an integral part of the radio frequency power source used by the plasma processing system.

43. The plasma processing system of claim 32, further comprising a filter component including inductive elements and capacitive elements configured to filter a signal input into the

matching network and wherein the match network component includes capacitive elements coupled to the at least one variable inductive element to provide impedance matching.

44. The plasma processing system of claim 32, further comprising a fan assembly including a fan unit configured to circulate air around the magnetic core of the variable inductive element to provide cooling of the magnetic core.

45. A high power, radio frequency matching network assembly for a plasma processing system, the matching network assembly comprising:

a plurality of variable inductive elements each including a magnetic core, a helical coil, and an actuator configured to physically translate the magnetic core through the helical coil; and

a housing including the plurality of variable inductive elements, the housing including a housing compartment partition that shields each of the variable inductive elements from fields generated by the other of the variable inductive elements.

46. The matching network assembly of claim 45, wherein the matching network is configured to deliver a maximum radio frequency power of 500 watts.

47. The matching network assembly of claim 45, wherein the matching network is configured to deliver a maximum radio frequency power of 1500 watts.

48. The matching network assembly of claim 45, wherein the matching network is configured to deliver a maximum radio frequency power of 2500 watts.

49. The matching network assembly of claim 45, wherein the matching network is configured to deliver a maximum radio frequency power of 3500 watts.

50. The matching network assembly of claim 45, wherein the matching network is configured to deliver a maximum radio frequency power of 4500 watts.

51. The matching network assembly of claim 45, wherein the matching network is configured to deliver a maximum radio frequency power of 5000 watts.

52. The matching network assembly of claim 45, wherein a temperature factor of permeability for one or the plurality of variable inductive elements is within the range of -1×10^{-6} to 40×10^{-6} .

53. The matching network assembly of claim 45, wherein the magnetic core of at least one of the plurality of variable inductive elements has a Curie temperature greater than 150°C .

54. The matching network assembly of claim 45, wherein the magnetic core of at least one of the plurality of variable inductive elements has a Curie temperature greater than 200°C .

55. The matching network assembly of claim 45, wherein the magnetic core of at least one of the plurality of variable inductive elements has a Curie temperature greater than 250°C .

56. The matching network assembly of claim 45 wherein the magnetic core of at least one of the plurality of variable inductive elements has a Curie temperature greater than 300°C .

57. The matching network assembly of claim 45, wherein the magnetic core of at least one of the plurality of variable inductive elements has a Curie temperature greater than 350°C .

58. The matching network assembly of claim 45 wherein the magnetic core of at least one of the plurality of variable inductive elements has a Curie temperature greater than 400°C.

59. The matching network assembly of claim 45, wherein the match network component is configured in a L circuit topology.

60. The matching network assembly of claim 45, wherein the match network component is configured in a T circuit topology.

61. The matching network assembly of claim 45, wherein the match network component is configured in a Pi circuit topology.

62. The matching network assembly of claim 45, wherein the match network component includes a filter component.

63. The matching network assembly of claim 45, further comprising a filter component located between an RF source of the system and the match network component.

64. The matching network assembly of claim 45, further comprising a filter component located between the a plasma load of the system and the match network component.

65. The matching network assembly of claim 45, wherein the magnetic cores are made of NiZn ferrite – Type 61.

66. The matching network assembly of claim 45, further comprising at least one reactive element and at least one capacitive element coupled to the plurality of variable inductive elements.

67. The matching network assembly of claim 45, further comprising at least one additional inductive element.

68. The matching network assembly of claim 67, further comprising inductive elements and capacitive elements configured to filter a signal input into the matching network assembly and capacitive elements coupled to the plurality of variable inductive elements to provide impedance matching.

69. The matching network assembly of claim 45, further comprising a plurality of fan assemblies each including a fan unit configured to circulate air around the magnetic core of one of the variable inductive elements to provide cooling of the magnetic core of the respective variable inductive element.

70. The matching network assembly of claim 45, wherein a surface area of each of the magnetic cores includes at least one of longitudinal and latitudinal grooves facilitating cooling of the magnetic core.

71. The matching network assembly of claim 45, wherein the magnetic cores of the inductive elements are the only movable elements of the variable inductive elements and any radio frequency current-carrying coils included in the impedance matching network are stationary.

72. The matching network assembly of claim 45, wherein moving the magnetic core of each of the variable inductive elements in and out of the helical coil included in each of the variable inductive elements changes the variable inductive element's inductance.